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GLOSSARY OF TERMS RELATING TO RIVER VALLEY PROJECTS

PART IX SPILLWAYS AND SIPHONS

(*First Revision*)

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GLOSSARY OF TERMS RELATING TO RIVER VALLEY PROJECTS

PART IX SPILLWAYS AND SIPHONS

(*First Revision*)

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GLOSSARY OF TERMS RELATING TO RIVER VALLEY PROJECTS

PART IX SPILLWAYS AND SIPHONS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (Part IX) (First Revision) was adopted by the Indian Standards Institution on 25 February 1982, after the draft finalized by the Terminology Relating to River Valley Projects Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 A number of Indian Standards have already been published covering various aspects of river valley projects and a large number of similar standards are in the process of formulation. These standards include technical terms and precise definitions of which terms are required to avoid ambiguity in their interpretation. To achieve this end, the Terminology Relating to River Valley Projects Sectional Committee is bringing out 'Glossary of terms relating to river valley projects' which is being published in parts. This part (Part IX) contains definitions of terms relating to spillways and siphons and to their various parts.

0.3 This standard was first published in 1968. The revision of the standard has been taken up in the light of the experience gained during the last few years in the use of this standard. Certain definitions of terms have been added. Some terms and figures have been modified.

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1. SCOPE

1.1 This standard (Part IX) contains definition of terms relating to types, design and parts of spillways and siphons.

2. TERMS RELATING TO TYPES OF SPILLWAYS

2.0 For the definition of 'Spillways', *see* **2.29**.

2.1 Automatic Spillway — A spillway which comes into operation automatically with the rise of water in the reservoir above a specified level.

2.2 Auxiliary Spillway — *See* **2.10.**

2.3 Breaching Section — A low earth bund or dike built across a low saddle in the rim of the reservoir, or in embankment reach intended to be washed out when the water reaches a predetermined elevation without endangering any other aspects by any further rise. It is also called 'Fuse Plug Spillway'.

2.4 Cascade Spillway — A spillway having a series of steps on the downstream face of the spillway for dissipation of energy by contact with successive steps. It is also called 'Stepped Spillway'.

2.5 Chute Spillway — A steep open channel normally lined conveying water usually at supercritical velocity, from the reservoir to the waterway downstream of the dam (*see* Fig. 1). It is also called 'Trough Spillway'.

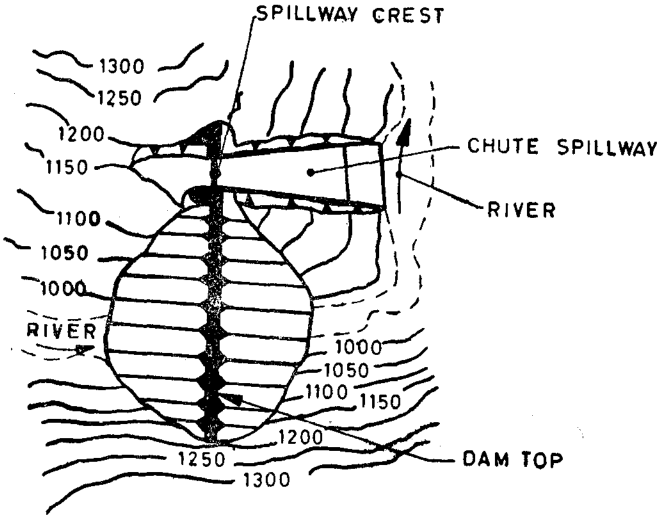

FIG. 1 CHUTE SPILLWAY

2.6 Closed Conduit Spillway — A spillway where a closed channel is used to convey the discharge around or through a dam. Spillways of this type include shaft spillways.

2.7 Controlled Spillway — A spillway having means to control the outflow from the reservoir. It is also called 'Gated Spillway'.

2.8 Culvert Spillway — *See* **2.15.**

2.9 Drop Inlet Spillway — Spillway consisting of entrance structures shaped like Morning Glory (in a vertical flared funnel with its top as the lip of the spillway), with central vertical or inclined shaft that carries discharge downward to tunnels loading to river channel below the dams. It is also called 'Shaft Spillway'. 'Morning Glory Spillway', or 'Glory Hole Spillway' (*see* Fig. 2).

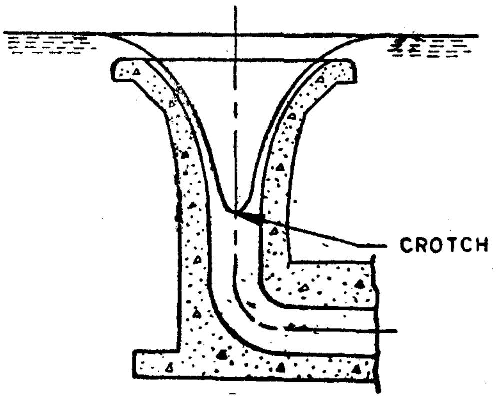

FIG. 2 DROP INLET SPILLWAY OR SHAFT SPILLWAY

2.10 Emergency Spillway — An excavated or natural channel, usually some distance away from a dam, provided to permit the release of extra ordinary flood flows or flood discharge beyond the capacity of the service spillway. Control gates are seldom furnished and a low embankment of earth may be used to allow the water surface of the reservoir to rise above the crest of the emergency spillway. If continued in flow causes overtopping of the embankment plug, it is intended that the plug shall wash away, releasing the excess water without endangering the main dam. It is also called 'Auxiliary Spillway' (*see* Fig. 3).

2.11 Flat Crested Morning Glory Spillway — A circular spillway composed of three parts: (a) sloping weir section, (b) free falling section, and (c) the vertical shaft section. The water is made to approach the crest of the free falling section, on a flat slope before beginning its free fall (*see* Fig. 4).

2.12 Fuse Plug Spillway — *See* **2.3**.

2.13 Gated Spillway — *See* **2.7**.

2.14 Glory Hole Spillway — *See* **2.9**.

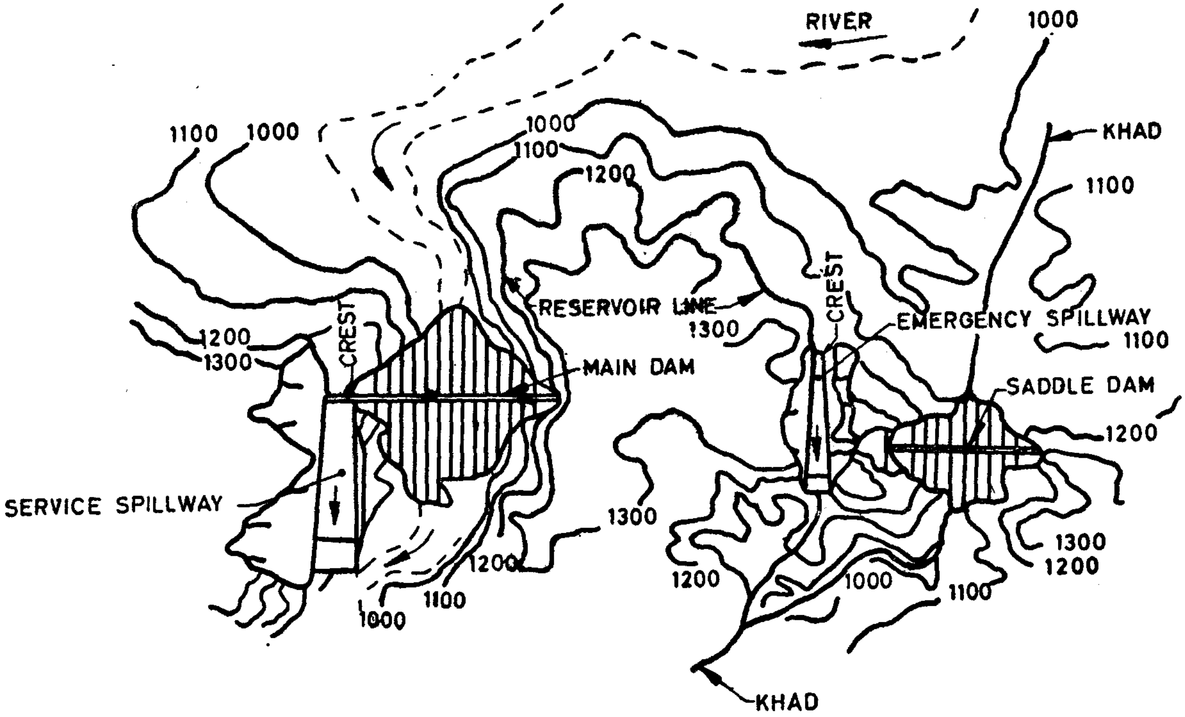

Fig. 3 Emergency Spillway

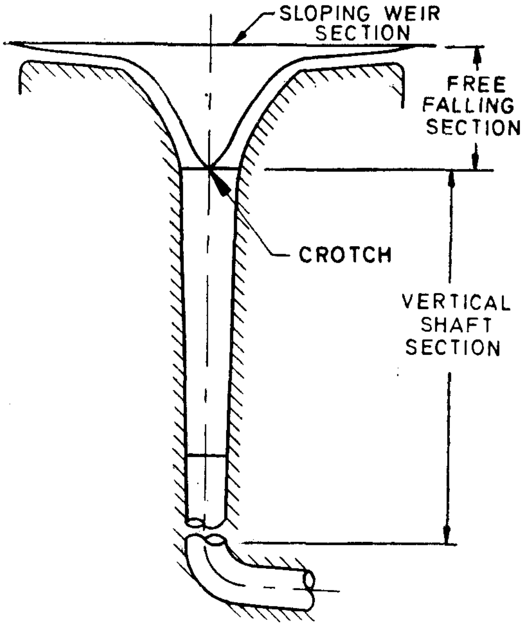

Fig. 4 Flat Crested Morning Glory Spillway

2.15 Inclined Tunnel Spillway — A spillway comprising a steeply inclined tunnel connected to the reservoir and having control devices (gates) at its inlet end.

2.16 Lateral Flow Spillway — *See* 2.27.

2.17 Limited Service Spillway — Any spillway that may be utilized in frequently for operation of the reservoir without incurring excessive damage to the spillway structure from erosion or to downstream areas from deposition of eroded material. Some extraordinary maintenance expenditure at relatively infrequent intervals would be accepted in order to reduce initial project construction costs, but not to the extent of imposing significantly adverse limitations on the potimum utilization of the controlled storage capacity of the reservoir under normal operating conditions.

2.18 Main Spillway — The spillway which is designed to pass the spillway design flood and which usually comes into operation. The main spillway may be assisted by the emergency spillways in passing the design flood.

2.19 Morning Glory Spillway — *See* **2.9**.

2.20 Ogee Type Spillway — *See* **2.22**.

2.21 Overfall Spillway (Straight Drop Spillway) — A spillway constructed on small bunds designed to permit water to pass over its crest. It is a low weir and is a simple vertical fall type structure.

2.22 Overflow Spillway (Ogee Spillway) — It is an improvement upon the free overfall spillway for higher depths of water and is widely used with concrete, masonry, arch and buttress dams. The profile of the spillway is made in accordance with the lower nappe of a free falling jet over a duly ventilated sharp crested weir for the design head.

2.23 Rollway — *See* **2.22**.

2.24 Separated Spillway — A spillway built as appurtenent work and not as a section of dam. When the spillway is located across a saddle, it is termed as saddle spillway.

2.25 Service Spillway — Any spillway that is normally utilised to discharge surplus waters. The downstream channel is protected by paving, so that it is not damaged due to high impact and velocities of the water.

2.26 Shaft Spillway — *See* **2.9**.

2.27 Side Channel Spillway — A spillway in which the initial and final flow are approximately at right angle to each other. The water, after passing over the spillway weir or ogee crest, being carried away by a channel running essentially parallel to the spillway crest (*see* Fig. 5). It is also called 'Lateral Flow Spillway'.

2.28 Siphon Spillway — A spillway operating on shiphon principle.

2.29 Spillway — A waterway in a dam or other hydraulic structures for the escape of flood/excess water. It may be located either within the body of the dam or at one end of it or entirely away from it, independently in a saddle.

2.30 Standard Crested Morning-Glory Spillway — A circular spillway having its shape at the top conforming to the 'standard crest' (*see* **3.7**). The water begins its free fall immediately upon leaving the crest (*see* Fig. 6).

2.31 Stepped Spillway — *See* **2.4**.

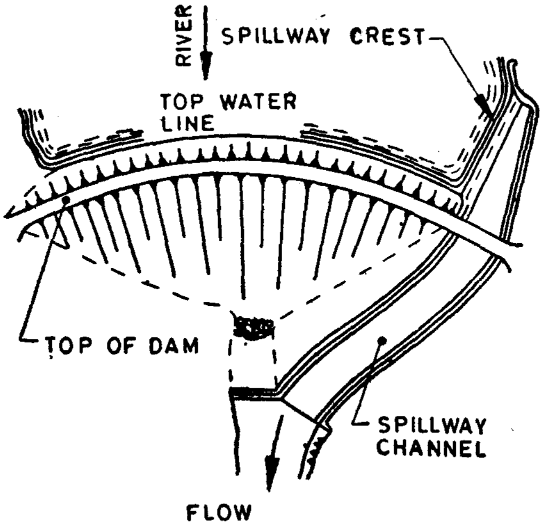

Fig. 5 Side Channel Spillway

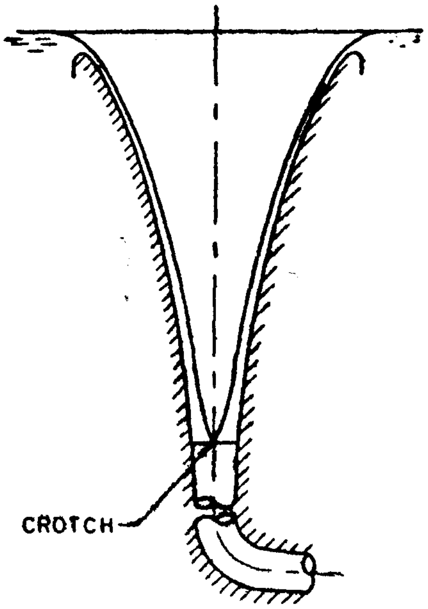

Fig. 6 Standard Crested Morning Glory Spillway

2.32 Submerged Spillway — A spillway in which the water level downstream stands at an elevation higher than the crest of the spillway.

2.33 Surplussing Works — Hydraulic structures which lead away surplus water (not required to be stored in the reservoir) safely to the river lower down or to natural escape.

2.34 Trough Spillway — *See* 2.5.

2.35 Tunnel Spillway — A tunnel used as an outlet channel for a side channel spillway.

2.36 Uncontrolled Spillway — A spillway, the crest of which permits water to escape automatically, as the water level in the reservoir rises above the crest. It is also called 'Ungated Spillway'.

2.37 Ungated Spillway — *See* 2.36.

3. TERMS RELATING TO DESIGN AND PARTS OF SPILLWAYS

3.1 Body Wall — The solid structure to withstand water pressure and to support the crest.

3.2 Chute — The water carrier open channel used for conveying water from the reservoir to the energy dissipator or appron to meet the river channel downstream of the dam. It is an inclined conduit or open channel having a steep slope for conveying water over high drops.

3.3 Chute Blocks — Triangular blocks installed at the u/s end of the stilling basin. The chute blocks are used to form serrated device at the entrance to stilling basin. Their function is to furrow the incoming jet and lift a portion of it from the floor, producing a shorter length of jump than would be possible without them.

3.4 Control Structure — A major component of a spillway that regulates and controls the outflows from the reservoir.

3.5 Crest — The line or area defining the top of the overflow section of a spillway.

3.6 Crotch — The point in the vertical limit of a morning glory or shaft spillway where the annular flow over the crest turns in a solid jet flow (*see* Fig. 2 and 6).

3.7 Datum Shape — The shape of spillway cross-section which corresponds to or coincides with the natural (basic) profile of the lower nappe surface for the design discharge. This will be the smallest cross-section as well as the most efficient shape on which no significant negative pressure, will exist for the design discharge. It is also called 'Standard Crest Shape'.

3.8 Discharge Carrier — It is that portion of a spillway, which extends from the control structure to the energy dissipator or to the downstream end of the spillway. It is also called 'Face of the spillway'.

3.9 Entrance Channel — A channel which conveys water from the reservoir to the control structure of a spillway.

3.10 Face of the Spillway — *See* **3.8.**

3.11 Free Jump —Jump formed when the tail water depth equals to the conjugate depth.

3.12 Friction Blocks — Rectangular blocks provided in two rows, one opposite to the other installed on the basin floor between chute blocks and end sill.

3.13 Glacis — A straight or curved floor sloping below and in continuation of the raised crest or sill of a weir or a fall structure.

3.14 Glory Hole — The vertical part of the shaft of a glory hole spillway.

3.15 Hydraulic Jump — The sudden and usually turbulent passage of water from low level below critical depth to high level above critical depth during which the velocity passes from supercritical to subcritical. It represents the limiting conditions of the surface curve wherein it tends to become perpendicular to the stream bed.

3.16 Nappe — A sheet of water overflowing a weir, fall, etc. The nappe has upper and lower surfaces.

3.17 Ogee — A reverse curve, shaped like an elongated letters S. The downstream faces or overflow spillways are made to this shape.

3.18 Origin of the Jump — The origin of the jump is the point where the roller turbulence begins and the water becomes white and foamy because of the large amount of entrained air.

3.19 Oscillating Jump — A type of hydraulic jump where the entering jet oscillates back and forth, from the bottom to surface and back again with no periodicity. The froude number of the incoming flow in this case is between 2·5 and 4·5.

3.20 Projecting Corbel — A projection provided on the upstream face of the ogee spillway for effecting saving in concrete. This is provided in the spillway where there are no gates.

3.21 Repelled Jump — Jump formed when the tail water depth is less than the conjugate depth.

3.22 Spillway Design Flood — The flood which after a thorough study of the hydrology of the drainage area, has been decided to be considered for design of the structure.

3.23 Spillway Elements or Spillway Components — Parts of a spillway which convey, control, carry away, discharge, destroy excess energy and finally lead water to an outlet channel and comprising all or some of the following: (a) entrance channel, (b) control structure, (c) discharge carrier, (d) energy dissipator, and (e) spillway outlet channel.

3.24 Spillway Outlet Channel — A channel connecting the stilling basin at the downstream end of the spillway to the river channel or other drainage channel below the dam.

3.25 Standard Crest Shape — *See* **3.7**.

3.26 Steady Jump — A type of hydraulic jump in which a stable and well balanced jump occurs. Turbulence is confined to main body of the jump and the water surface d/s is comparatively smooth. The froude number of the incoming flow in this case is between 4·5 and 9·0.

3.27 Submerged Jump — Jump formed when the tail water depth is greater than the conjugate depth.

3.28 Undular Jump — A type of hydraulic jump in which the water surface shows undulations. The froude numbers of incoming flow in this case is between 1 and 1·7.

3.29 Weak Jump — A type of hydraulic jump in which a series of small rollers develop on the surface of the jump, but the d/s water surface remains smooth. The velocity throughout is fairly uniform and the energy loss is low. The froude number of the incoming flow in this case is between 1·7 and 2·5.

4. TERMS RELATING TO TYPES OF SIPHON

4.0 For the definition of 'Siphon', *see* **4.10**.

4.1 Baby Siphon — A smaller siphon operating at a lower level than the main siphon.

4.2 Battery of Siphons — A number of siphons installed close to each other.

4.3 High Head Siphon — A siphon acting under a difference in water level of more than the barometric height of water column, that is, 10·33 m.

4.4 Hood Siphon — A siphon having its duct formed of a U-shaped hood. The inlet lip of the hood is submerged below the full reservoir level and that of the outlet lip terminates in a water seal formed by various devices. It is also called 'Saddle Siphon'. The siphons are, sometimes, named according to the water seal provided (*see* Fig. 7).

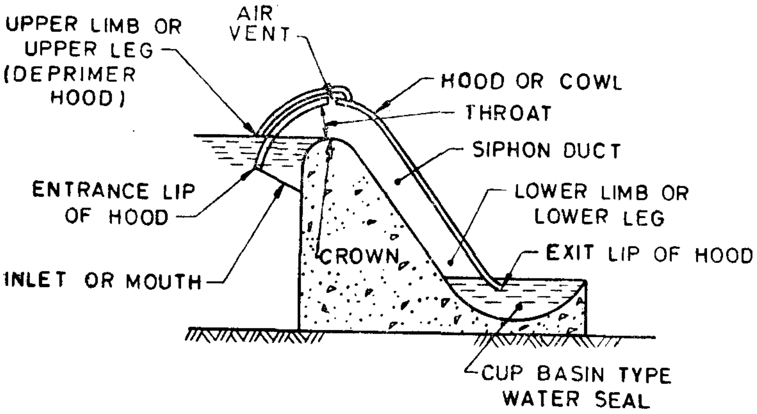

FIG. 7 HOOD SIPHON

4.5 Inverted Siphon — A pipe line crossing over a depression or under a highway, railroad, canal, etc. The term is common but inappropriate, as no siphonic action is involved. The term 'Sag Pipe' is more expressive and appropriate. It is also called 'Irrigation Siphon'.

4.6 Low Head Siphon — A siphon acting under a difference in water level of less than the barometric height of water column, that is, 10·33 m.

4.7 Maramsilli Baby Siphon — A siphon in which a water seal is provided by a baby siphon, which being at a lower level gets primed earlier and its issuing jet seals the downstream of the siphon duct (*see* Fig. 8).

4.8 Priming Siphon — A siphon device, usually of smaller capacity installed with a main siphon or battery of siphons to reduce priming depth in the latter.

4.9 Saddle Siphon — *See* **4.4**.

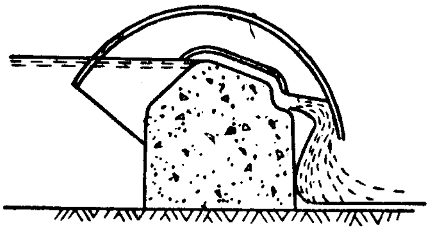

FIG. 8 MARAMSILLI BABY SIPHON

4.10 Siphon or Syphon — A closed conduit (duct) a part of which rises above the hydraulic grade line. It utilizes atmospheric pressure to effect or control the flow of water through it.

4.11 Volute Siphon — A siphon consisting essentially of a dome with a funnel, having volutes either on its inner curved surface or on the outside of vertical pipe near its top, placed underneath, leaving an annular space round, with a vertical pipe taken down the funnel to pass the discharge through the dam. The dome is supported by a cylindrical drum resting on pillars leaving an annular space alround the funnel (*see* Fig. 9).

5. TERMS RELATING TO DESIGN AND PARTS OF SIPHONS

5.1 Parts of Hood Siphon

5.1.1 *Cowl* — It is the U-shaped body made of reinforced concrete and used over the body wall to form a siphon duct. Also called 'Hood' (*see* Fig. 7).

5.1.2 *Crown* — The highest ridge of the hood (*see* Fig. 7).

5.1.3 *Entrance Lip of Hood* — The upstream edge of the hood which has to remain submerged below the full reservoir level for siphonic action to begin (*see* Fig. 7). It is also called 'Upper Lip of Hood' or 'Upstream Lip of Hood'.

5.1.4 *Exit Lip of Hood* — The downstream edge of the lower lip (*see* Fig. 7).

5.1.5 *Hood* — *See* **5.1.1**.

5.1.6 *Inlet or Mouth* — (a) The normal distance between the entrance lip of hood and the body wall or (b) The section between the entrance lip of hood and the body wall through which water enters the siphon (*see* Fig. 7).

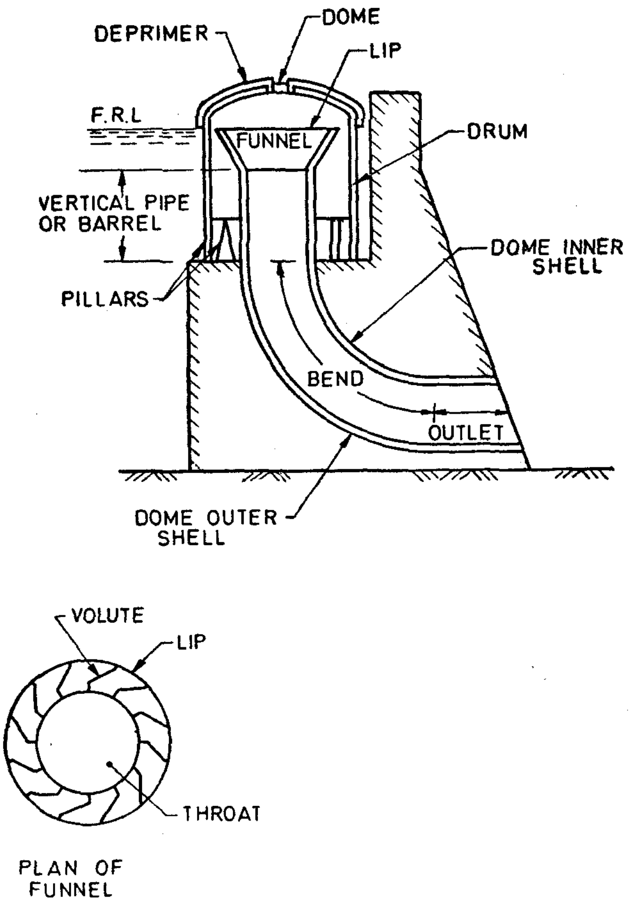

FIG. 9 VOLUTE SIPHON/GANESH IYER SIPHON

5.1.7 *Lower Limb or Lower Leg* — The portion of the hood between the crown and the exit lip (*see* Fig. 7).

5.1.8 *Siphon Duct or Siphon Barrel* — It is the annular space between dam (Body Wall) and the hood (*see* Fig. 7).

5.1.9 *Throat* — The minimum distance between the highest point of the crest of the dam (Body Wall) and the lower surface of the hood (*see* Fig. 7).

5.1.10 *Tudel or Offset* — Projection on the wall in lower leg to throw the discharge on to the outer covering to create water seal.

5.1.11 *Upper Limb or Upper Leg* — The portion of the hood from the inlet lip to the crown (*see* Fig. 7).

5.1.12 *Water Cistern* — Cistern provided to maintain water seal at the end of lower leg of the siphon.

5.2 Parts of Volute Siphon

5.2.1 *Barrel* — The vertical shaft of a volute siphon (*see* Fig. 9).

5.2.2 *Boil Point* — The point where jet shooting from the funnel meets the centre of barrel in the earliest possible time.

5.2.3 *Dome* — A hemispherical covering with springing at a level slightly higher than the lip level and resting over the drum such that at no point the distance measured in a direction normal to curvature be less than the annular space between the drum and the lip (*see* Fig. 9).

5.2.4 *Drum* — The vertical cylindrical structure having dome on its top and bell mouth entrance at the bottom having the same diameter as that of the dome.

5.2.5 *External Volute* — *See* **5.2.9**.

5.2.6 *Funnel* — The cantilevered portion of the barrel alround at the entrance to minimize entry losses (*see* Fig. 9).

5.2.7 *Internal Volute* — *See* **5.2.9**.

5.2.8 *Pillars* — Pillars built on body to support the drum (*see* Fig. 9).

5.2.9 *Volutes* — These are the curved vanes or projections placed on the inner sloping surface of the funnel shaped top of the barrel (called 'Internal Volute') or on the outer side of the barrel near its top (called 'External Volute').

5.3 Terms Relating to Priming

5.3.1 *Deprimer* — A device which breaks the priming in a siphon by admitting air through its inlet and located at full reservoir level or a little below.

5.3.2 *Primer* — A priming device.

5.3.3 *Priming* — The action of siphon between the instance when the water just begins to spill over the crest in case of saddle siphon or over the lip of funnel in case of volute siphon and the instance when the siphon comes in full operation. The time that elapses between the two instances is termed as 'Priming Time'. The condition of having the siphon in full operation is termed as 'Primed'. This condition may be said to have been attained when the outlet starts to flow full bore.

5.3.4 *Priming Depth* — The rise in the reservoir level above the crest of siphon for full operation of the siphon.

5.3.5 *Priming Time* — *See* **5.3.3**.

5.3.6 *Volute Priming* — The priming effected by the action of volutes in a volute siphon by way of imparting spiral motion to the entering water.

5.4 Terms Relating to Different Types of Water Seals

5.4.1 *Auxiliary Siphon Type Water Seal* — A water seal made effective by the provision of a baby siphon placed either in front, or by the side of the main siphon. The two siphons are connected through a pipe conduit.

5.4.2 *Baby Siphon Type Water Seal* — Water seal provided by a baby siphon like Maramsilli baby siphon (*see* **4.7** and Fig. 8).

5.4.3 *Baffle Type Water Seal* — A water seal made effective by constructing a baffle or step in the outlet invert (*see* Fig. 10).

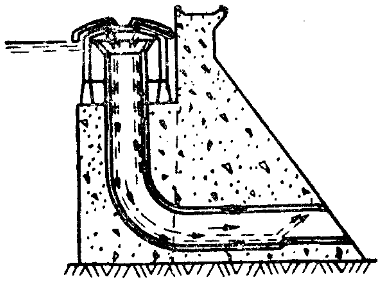

FIG. 10 BAFFLE TYPE WATER SEAL

5.4.4 *Clear Overfall Type Water Seal* — Water seal obtained when the top of the body wall is rounded off so as to throw the water on to the outer shell of lower limb at the exit lip (*see* Fig. 11).

5.4.5 *Cup Basin Type Water Seal* — A water seal made effective by dipping the lower limb of the hood into a cup-like basin provided on the downstream (*see* Fig. 7).

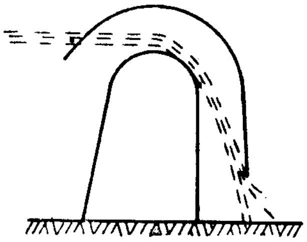

FIG. 11 CLEAR OVERALL TYPE WATER SEAL

5.4.6 *Joggle Type Water Seal* — Water seal obtained by providing a step or a series of steps at the rear of the body wall to throw water on inner surface of the lower limb (*see* Fig. 12). It is also called 'Tudel Type Water Seal', 'Stepped Type Water Seal' or 'Offset Type Water Seal'.

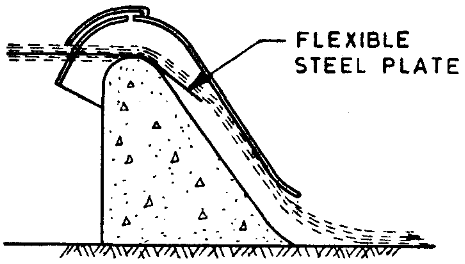

FIG. 12 JOGGLE TYPE WATER SEAL

5.4.7 *Maramsilli Baby Siphon Type Water Seal* — *See* **5.4.2**.

5.4.8 *Mechanically Induced Water Seal* — Water seal obtained by mechnical means, such as (a) by installing an air pump to suck out air from the siphon, or (b) by installing a flexible steel plate at the crest and projecting into the siphon duct (*see* Fig. 13).

5.4.9 *Obstruction Weir Type Water Seal* — A water seal provided by a low weir (subsidiary dam) constructed downstream of the body wall (dam) (*see* Fig. 14).

5.4.10 *Offset Type Water Seal* — *See* **5.4.6**.

5.4.11 *Overfall Weir Type Water Seal* — A water seal made effective by the mingling of two over-flowing opposite nappes in the duct near the crest of the body wall (dam). A small receptacle to admit water from the reservoir for the above purpose is located opposite to the crest (*see* Fig. 15). It is also called ' Priming Weir Type Water Seal '.

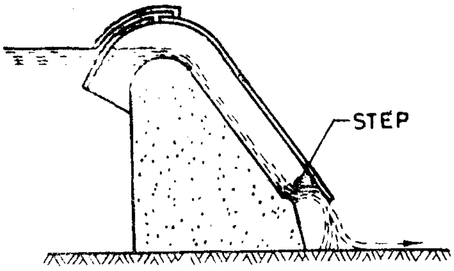

Fig. 13 Mechanically Induced Water Seal

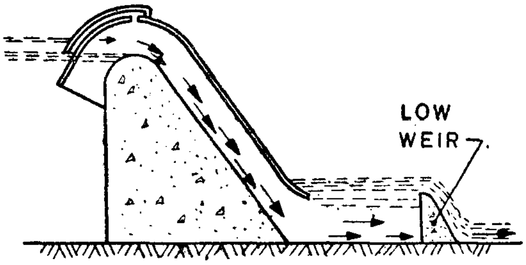

Fig. 14 Obstruction Weir Type Water Seal

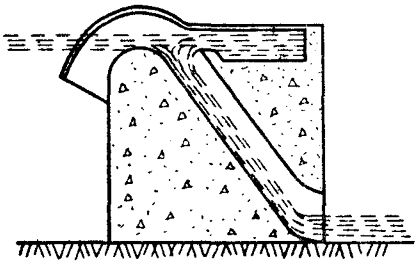

Fig. 15 Overall Weir Type Water Seal

5.4.12 *Priming Weir Type Water Seal* — *See* **5.4.11**.

5.4.13 *Stepped Type Water Seal* — *See* **5.4.6**.

5.4.14 *Tilted Outlet Type Water Seal* — Water seal is made effective at the bend of the outlet pipe by tilting the outlet pipe upwards (*see* Fig. 16).

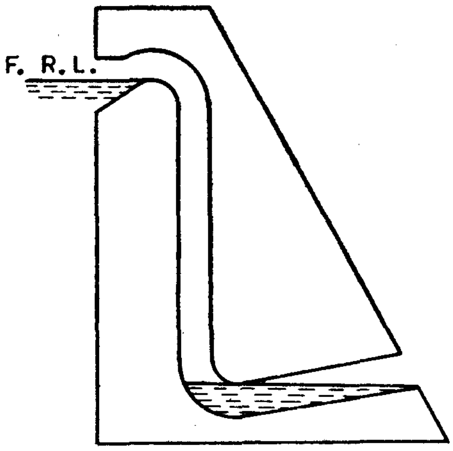

FIG. 16 TILTED-OUTLET TYPE WATER SEAL

5.4.15 *Tudel Type Water Seal* — *See* **5.4.6**.

5.4.16 *Water Seal* — Device for effectively shutting off air from getting into the hood in case of saddle siphon and into the barrel in case of volute siphon.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg.m/s^{2}
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^{2}
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^{2}

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